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**Research Article**

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# Design and implementation of flowers watering control system based on the zigbee

**Shuangde Zhang**

*Wuhan Polytechnic University, Wuhan, P. R. China*

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**ABSTRACT**

*The design of flower watering control system is to use wireless sensor network, timely and accurately collect the temperature and humidity, and illumination parameters of the flower cultivation environment. Then the data is sended to the control center through the Zigbee wireless network. After receiving the data, control center processes and deals with the data, gives instructions by the Zigbee wireless network for spray irrigation system.*

**Key words:** Wireless sensor network, watering, control

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## INTRODUCTION

The design of flower watering control system is to use wireless sensor network, accurately to collect the temperature and humidity, and illumination parameters of the flower cultivation environment. then the data is sent to the control center through the Zigbee wireless network. After receiving the data, control center processes and deals with the data, then gives instructions by the Zigbee wireless network for spray irrigation system. At the same time, the control center dynamically generates real-time data into web pages, published on the web server[1]. The administrator can directly access at the terminal end, view and manage flower planting environment in the greenhouse. Administrators can also, through the mobile phone, get the corresponding parameters, send text messages, and control spray irrigation and illumination system in greenhouses by way of texting. Figure 1 is the wireless sensor nodes in the project.

Wireless sensor network (WSN) is a key technology of realization of internet of things, which changed the way the information transmission between the things by fusing the objective physical world together as did the Internet change the way of communication between people.

**Figure 1 Wireless sensor network node**

Wireless sensor network is composed of three elements: perceived object, sensors and observer. A large number of tiny sensors are deployed in monitoring area, they are collaborative sense, acquire and process perceived object in the monitoring area and then form a self-organization network through the way of wireless communication[3-6]. With the aid of the network sensors information of the perceived objects will be sent to the observer.

Considering the hardware design of sensor nodes, and realize the corresponding function of software development, this project used the ZigBee technology to implement wireless sensor network (WSN). ZigBee is a kind of low power-consumption, low rate, low energy-consumption, close two-way wireless communication technology. The node of ZigBee is small in size, which can network automatically and the network has strong self-healing ability. Any node to leave won't be a fatal impact on the network, so it is suitable for a wireless sensor network (WSN).

In order to realize real-time monitoring of greenhouse environment through the ZigBee wireless sensor network technology, system model this project established is shown in figure 2.

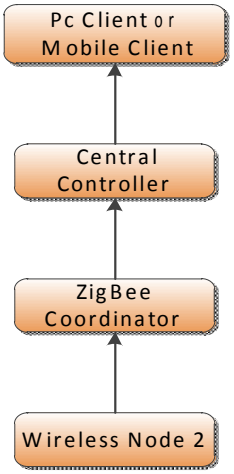


**Figure 2 Flower cultivation model of the system**

## THE DESIGN

*Structure design of flower watering system*

Flower watering system is developed in the following way. The temperature sensor, humidity sensor , and light sensor installed in the greenhouse collect or observe environmental factors such as indoor temperature, humidity, illumination, which are controlled by greenhouse equipment and adjusted to the need of cultivation of crop growth and development. Hence, the flower watering system provides the suitable ecological environment for the growth of flowers and plants[8], which greatly reduces the workers labor intensity, and improves the quality of the rare flowers.

*Wireless sensor network hardware design and implementation*

Wireless sensor network consists of two classes of hardware platform：the coordinator node, sensor acquisition node. In addition， in the design of wireless sensor networks, such as debugging process[7], some auxiliary equipments, such as programmer, emulator, etc are still needed. The structure diagram of wireless sensor network system is shown in figure 3 below.

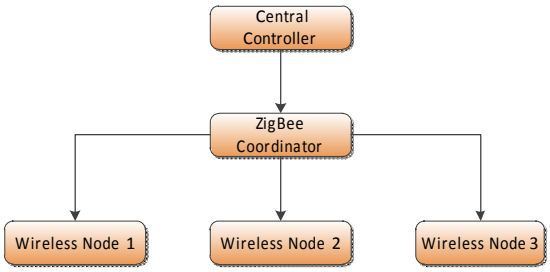


**Figure 3 the structure of wireless sensor network system**.

The coordinator node and the center controller communicate via a serial port RS232 connection, and sensor nodes

and the coordinator node communicate through the ZigBee wireless sensor network. Flower watering control system monitors the real-time greenhouse environmental parameters (such as temperature, humidity and light intensity), and taking full advantage of the two-way communication function of the Zigbee network, the center controller gives watering instructions. Receiving the instructions, electromagnetic valve, connected to the wireless nodes, immediately starts to work to complete the process of watering.

Greenhouse environment monitoring is a self-organizing network composed of integrated sensor, data processing unit and communication module of nodes. Wireless sensor network has the following advantages such as high detection precision, large covering area, fault tolerance and capability of remote monitoring, etc. network nodes in hardware design requires lower cost, smaller power consumption, long service life, therefore low-power and low-cost chip should be used in hardware design. Meanwhile, the software must support multiple hops routing protocol. In order to decrease the complexity of hardware design and improve the stability of the radio frequency communication system, CC2530 chip of TI company is used to control the hardware. CC2530 chip is compatible with IEEE 802.15.4 on system, support proprietary 802.15.4 market and ZigBee, ZigBee PRO and ZigBeeRF4CE standards. The coordinator node is mainly composed of intelligent mainboard module and wireless nodes module. Sensor acquisition node is mainly composed of sensor module and intelligent mainboard module and module of wireless nodes.

*Wireless nodes design*

Wireless node module mainly consists of rf MCU. MCU is TI CC2530 chip, with the carrier frequency 2.4 G, rod antenna. Wireless sensor part CC2530 uses core board design, which is separated from the base plate design, easy to replace and programme. The overall module use 5 V power supply input, internally uses DC/DC chip into 3.3 V (maximum output current 200 ma). CC2530 system uses single chip solution. CC2530 chip signal conducts from the module level and comes into system planning. electric manual reset chips are used on reliable power reset operation. 5 feet FPC is used to conduct 2 line socket DEBUG interface signals. Wireless node module chart is shown in figure 4:

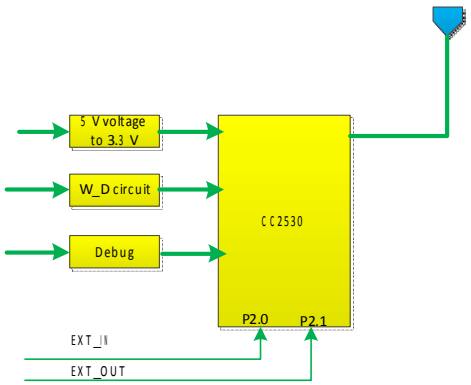


**Figure 4 Wireless node module chart**

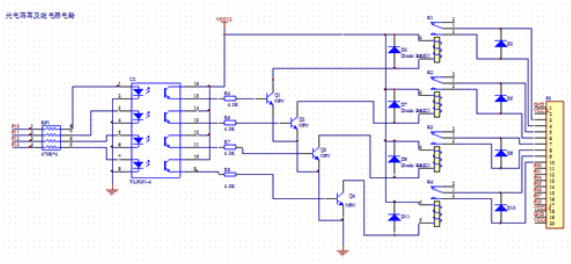

**Figure 5 Temperature and humidity sensor**

*Selecting temperature and humidity sensor*

Based on the technology of COMSens, SHT11, by Swiss Sensirion , are novel, high precision temperature and humidity sensor with free calibration, free debugging, digital output and free peripheral circuit, etc. Temperature and humidity sensor SHT11 humidity sensors is internally integrated with temperature sensors, 14 A/D converter, signal disposal, CRC generator and fieldbus interface module. With the effective combination of the advantages of CMOS chip technology and sensor technology, SHT11can reduce the sensor size, improve its performance,and facilitate to interface and processor. As shown in figure 5.

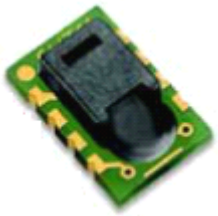

**Figure 6 Relay output circuit**

*Relay output circuit*

The main function of output circuit is to control the switch of electromagnetic valve to implement watering flowers, turn on the lamp, when necessary to complete the role of light. Circuit design as shown in figure 6.

*Principle design of the center controller circuit*

The center controller is connected to the coordinator. By sending commands to the coordinator, it completes the data collection of the wireless nodes in wireless sensor network. At the same time, it posted the real-time dynamic data on the Internet in the form of a WEB page. the administrator can monitor greenhouses watering system by logging into the center controller. The center controller is configured with GPRS module and interface, as well as the 3 g module Group, which makes the data publication to the internet possible even though there is no internet access points in the greenhouse. The center controller uses the Linux operating system, and the processors is S3C6410 from Samsung company. S3C6410 is of a big capacity, low cost , high performance ARM processor. This part of the code was written under Linux, with a stable performance.

*GPRS circuit design*

GPRS (General Packet Radio Service (General Packet Radio Service)is a GSM mobile phone a mobile data Service available to the user. GPRS is a continuation of the GSM. Unlike the continuous channel transmission, GPRS transmits by the Packet . GPRS is often described as "2.5 G", that is to say it is between the second generation (2 G) and third-generation (3 G) mobile communication technology. It by using unused TDMA channels in the GSM network, provides the medium data transfer. The GSM network can only provide the circuit switching mode of thinking. i GPRS can achieve packet switching only by increasing the corresponding function entity and transforming part of the base station system. The cost of the transformation is relatively cheap , but the user data rate is considerably improved. SIM300 is a TCPIP GPRS module. It can realize GPRS network and text message. It can be set into DTU mode, which is easy to use and with reliable performance. Figure 7 is SIM300 circuit design .

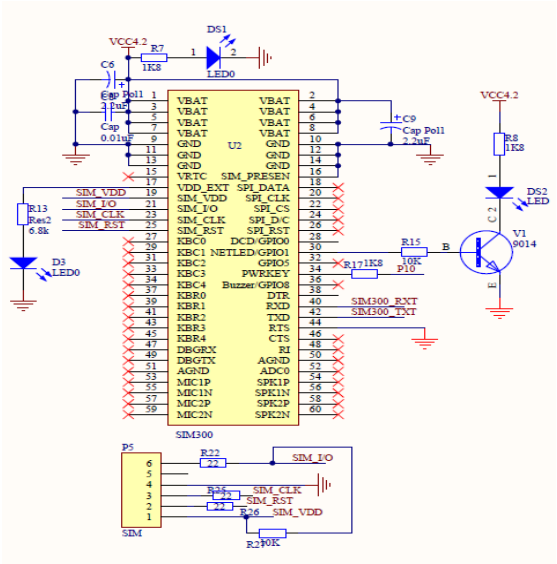


**Figure 7 GPRS interface section**

*Other extended interface*

To make the system function perfect, the center controller leaves the USB Host port in this project to expand in the future. WiFI, Camera can be used by this interface to expand. As shown in figure 8.

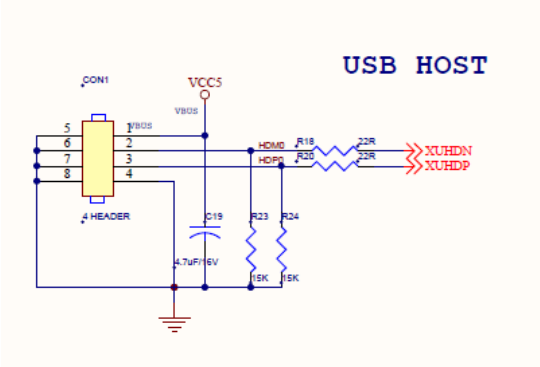


**Figure 8 Extended USB HOST interface**

*Software system design*

The software system can be broadly divided into two parts. The first part of the software is running software CC2530 wireless sensor node and the coordinator to collect software. This part of the software is based on TI company Z - Stack platform, compiling environment is IAR Embedded Workbench 7.2. TI Z - Stack protocol Stack is based on the operating system of a rotation query. The main function of Stack is in ZMain. C. in general, it has totally done two jobs: one is the system initialization, namely to initialize the hardware system and software architecture needed by various modules by the startup code; Another is to perform operating system entities.

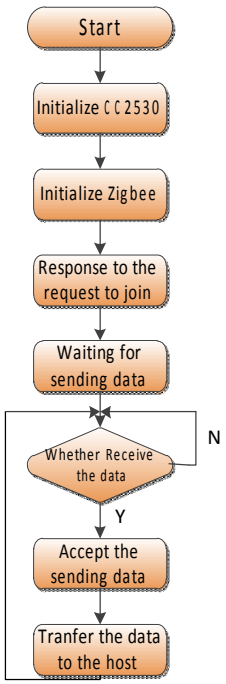


**Figure 9 The coordinator working process**

Coordinator collection nodes complete the sensor node communication and PC communication, waiting for the transmitting terminal to send data. Sensor collection node is mainly to send collected data, waiting for the coordinator to join in the network for wireless communications. When the ZigBee wireless radio frequency communication module CC2530 is reset after the power supply is connected, it first sets up a ZigBee network with a unique ID identification, and then answers the request of the binding of sensor module and adds it to the network. at the same time it distributes the only 16-bit address to the sending module within this network, and then waits for the final sensor module to send data. if data detected, it receives this data, and transmits to the central controller immediately through SP3232E receiver packets. The coordinator working process as shown in diagram 9 . Wireless sensor node software working process as shown in figure 10.

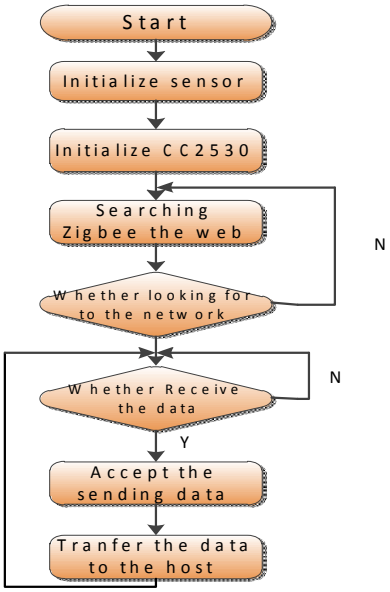


**Diagram 10 Wireless sensor node software working process**

The second part software is the center controller software. This part of the software runs under the Linux operating system. The main code is CGI program. On the center controller platform, with the running Thttpd WEB server, CGI program completes WEB publishing. administror can have remote access to the WEB server to control the flower watering system. Background CGI program is responsible for the interpretation of commands, and sending the commands through the serial port to the coordinator. In addition, GPRS module and short message processor software modules are implemented by central controller, based on the multithreaded application layer program under Linux.

## THE EXISTING PROBLEMS, IMPROVEMENTS AND FURTHER IN-DEPTH STUDY

The power supply part of the prototype concerned is considered in two ways. One is dc power supply, the other is battery. The battery power supply time is not very ideal in the actual application. Lithium ion battery is too costly and charging is a problem. So the power supply remains to be a problem to be solved.

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